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(71) Applicant(s)

Sony Corporation

(Incorporated in Japan)

6-7-35 Kitashinagawa, Shinagawa-ku, Tokyo 141,
Japan

(72) Inventor(s)

Hideaki Hanaoka

Hirofumi Kondo

Tomio Kobayashi

Mitsunori Ueda

(74) Agent and/or Address for Service

D Young & Co

21 New Fetter Lane, LONDON, EC4A 1DA,
United Kingdom

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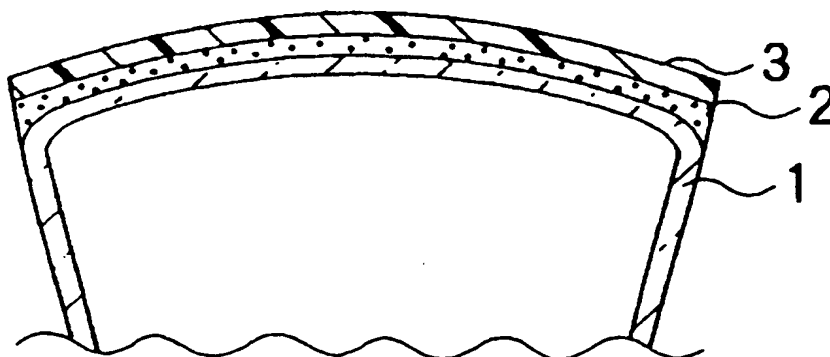
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(54) Display devices having anti-reflection filters

(57) A display device such as a cathode ray tube has an anti-reflection filter comprising a glass substrate 1, an anti-reflection film 2 comprising a single layer or multiple layers formed on the glass substrate 1, and a functional coating layer 3 comprising a compound made of a perfluoropolyether having a polar group at its end or a derivative thereof coated on the layer or the outermost layer of the anti-reflection film 2.

FIG. 2



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FIG. 1

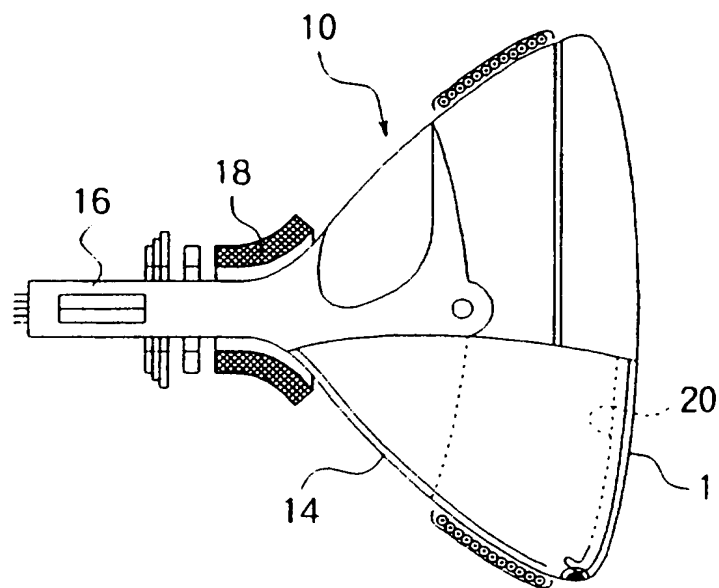


FIG. 2

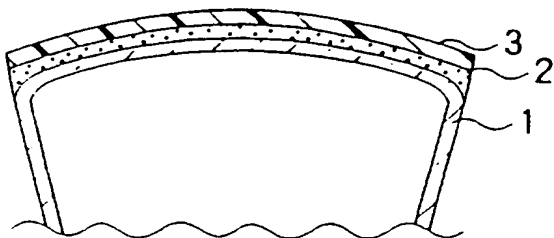


FIG. 3

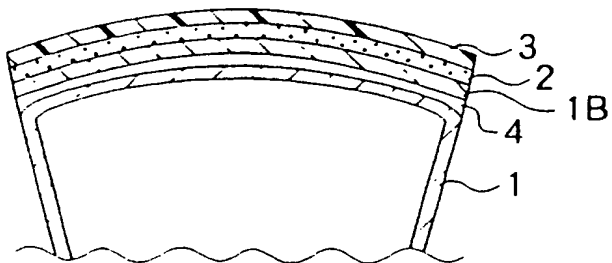
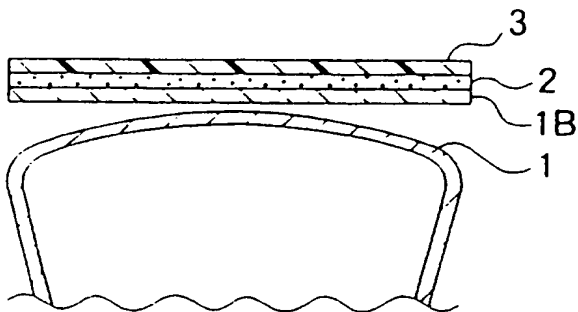


FIG. 4

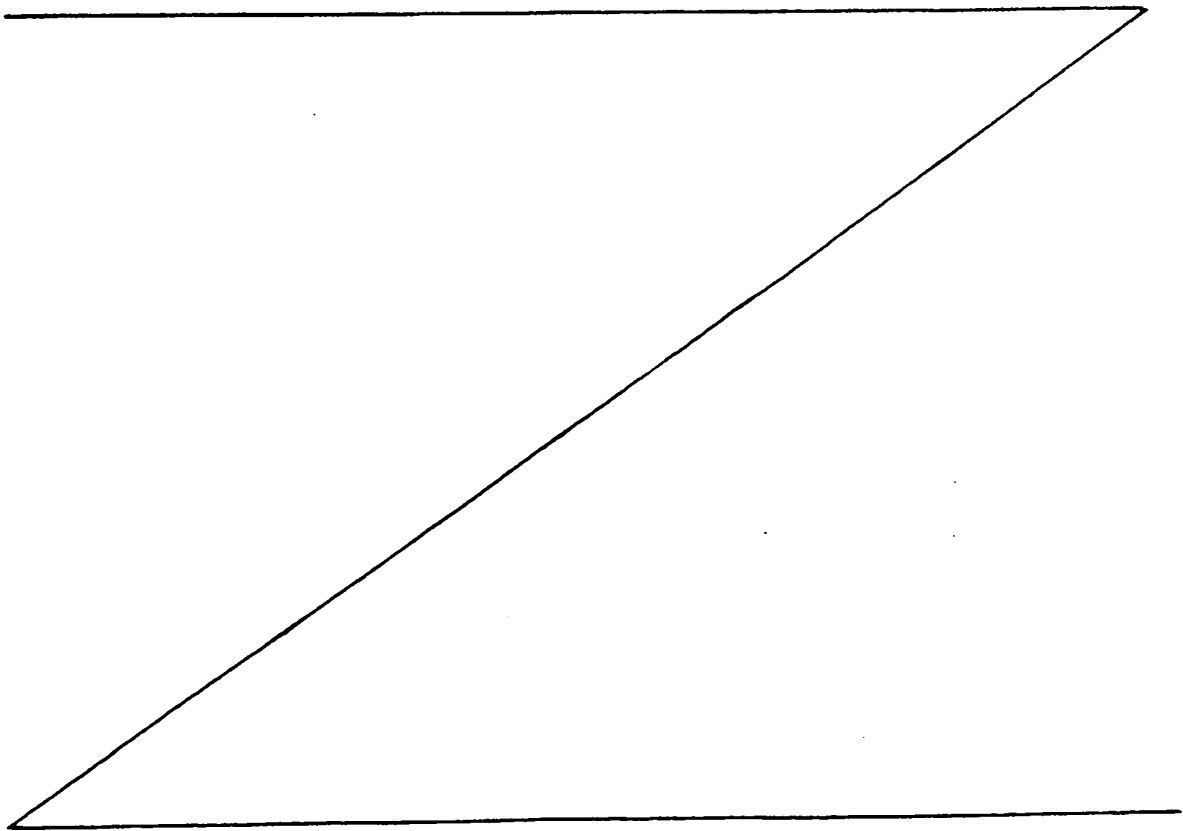


DISPLAY DEVICES HAVING ANTI-REFLECTION FILTERS

This invention relates to display devices (e.g. cathode-ray tubes (CRTs)) having anti-reflection filters.

5 When viewing an object through a transparent material, it is troublesome when the reflected light is strong and the reflected image is clear. For example, in lenses for eyeglasses, reflected images referred to as "ghosts", "flares", or the like occur and give an uncomfortable feeling to the eyes. Further, in looking glasses or the like, there is the disadvantage that the object cannot be discerned due to the light reflected
10 on the glass surface.

 In the past, the practice has been to coat a substrate with a substance having a different refractive index from that of the substrate by the vacuum deposition process or the like to prevent reflection. In this case, it is known to be important to select the thickness of the substance coating the substrate in order to make the anti-
15 reflection effect the highest.



For example, in a single layer coating film, it has been known that the selection of the optical thickness of the substance having a lower refractive index than that of the substrate to be $1/4$ of the wavelength of the light concerned or an odd number multiple thereof gives the minimum reflectivity, that is, the maximum transmissivity.

Here, the "optical thickness" is given by the product of the refractive index of the coating film-forming material and the thickness of the coating film. Further, formation of a plurality of anti-reflection layers is possible. Several proposals have been made concerning the selection of the thickness in this case (Optical Technology Contact, vol. 9, no. 8, p. 17 (1971)).

On the other hand, a method of forming an anti-reflection film made of a plurality of layers satisfying the conditions of the above optical thickness by using a liquid composition is disclosed in Japanese Unexamined Patent Publication (Kokai) No. 58-46301, Japanese Unexamined Patent Publication (Kokai) No. 59-49501, and Japanese Unexamined Patent Publication (Kokai) No. 59-50401.

An anti-reflection film formed on a glass substrate by the vacuum deposition process or

sputtering process mainly uses as the coating film-forming material an inorganic oxide or an inorganic halide. The anti-reflection film inherently has a high surface hardness, but conversely has the disadvantage that dirt due to finger marks, sweat, or hair liquids, hair sprays, and other cosmetics easily stands out and, further, this deposited dirt is difficult to remove. Further, it has a poor surface slip, therefore, it suffers from the disadvantage that scratches formed when coming into contact with some sort of hard object will become bigger. In addition, it has a high wettability with respect to water, therefore there is the disadvantage that, when rain drops or splashed water adhere to it, they spread widely and, in the case of eyeglass lenses or the like, cause objects to appear distorted over a wide surface area etc.

In order to impart a high surface hardness also to the anti-reflection film disclosed in Japanese Unexamined Patent Publication (Kokai) No. 58-46301, Japanese Unexamined Patent Publication (Kokai) No. 59-49501, and Japanese Unexamined Patent Publication (Kokai) No. 59-50401, it is necessary to incorporate into the outermost surface film an inorganic substance such as silica particulates in an amount of 30 percent by weight or more, but there is the disadvantage that

the anti-reflection film obtained from such a film composition has a poor surface slip and scratches are easily formed due to polishing by a cloth etc.

Various types of surface treatment agents have
5 been proposed for the purpose of improvement in these disadvantages and have been made commercially available, but all are dissolved by water or various types of solvents, function only temporarily, or lack permanence and are poor in durability. Further, Japanese
10 Unexamined Patent Publication (Kokai) No. 3-266801 reports formation of a layer of fluorocarbon resins so as to impart water repellency. In these fluorocarbon resins, however, while the water repellency was indeed increased, a satisfactory result with respect to
15 friction or abrasion could not be obtained.

20

According to the present invention, there is provided a display device having an anti-reflection filter comprising: a glass substrate; an anti-
25 reflection film comprising a single layer or multiple

layers formed on the glass substrate; and a functional coating layer comprising a compound made of a perfluoropolyether having a polar group at its end or a derivative thereof coated on the outermost layer of the anti-reflection film.

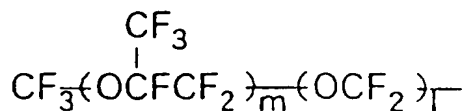
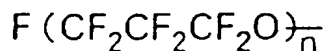
Preferably, the glass substrate comprises a glass panel of the display device.

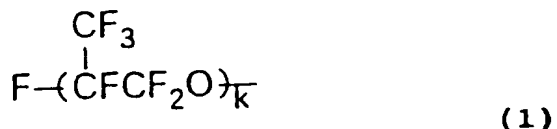
Preferably, the outermost layer of the anti-reflection film is mainly composed of SiO_2 or MgO_2 .

Preferably, at least one layer of coating film having a higher refractive index than that of the outermost layer is formed on the glass substrate.

Preferably, the molecular structure of the compound made of the perfluoropolyether having a polar group at its end or a derivative thereof has perfluoroalkoxyl groups of the various chain lengths as repeating units.

Preferably, the perfluoroalkoxyl groups have any one of the structures indicated by the following chemical formulae:





where 1, m, n and k indicate an integer of 1 or
 5 more respectively.

Preferably, the perfluoroalkoxyl groups have any
 one of the structure indicated by the following chemical
 formula:



(2)

where p and q indicate an integer of 1 or more
 respectively.

15 Preferably, the polar group which the compound
 made of a perfluoropolyether or a derivative thereof
 has at its end is any one of amino group, carboxyl
 group, hydroxyl group, alkoxysilyl group and phosphate
 group.

20 Preferably, the compound made of a
 perfluoropolyether having a polar group at its end or a
 derivative thereof has an average molecular weight of 500
 to 10000.

25 Preferably, the compound made of a
 perfluoropolyether having a polar group at its end or a

derivative thereof has an average molecular weight of 1000 to 5000.

Preferably, the functional coating layer comprising a perfluoropolyether having a polar group at its end or a derivative thereof has a thickness of 0.5nm to 100nm.

Preferably, the functional coating layer comprising a perfluoropolyether having
5 a polar group at its end or a derivative thereof has a thickness of 1nm to 20nm.

A preferred form of implementation of the invention described hereinbelow provides a display device having an anti-reflection filter of excellent dirt resistance, abrasion resistance, processing resistance, etc.

The invention will now be further described, by way of illustrative and non-
10 limiting example, with reference to the accompanying drawings, in which:

FIG.1 is a schematic cross-sectional view of a CRT;

FIG.2 is a cross-sectional view schematically showing the configuration of a surface portion of a CRT according to a first embodiment of the display device according to the present invention;

15 FIG.3 is a cross-sectional view schematically showing the configuration of the surface portion of a CRT according to a second embodiment of the display device according to the present invention;

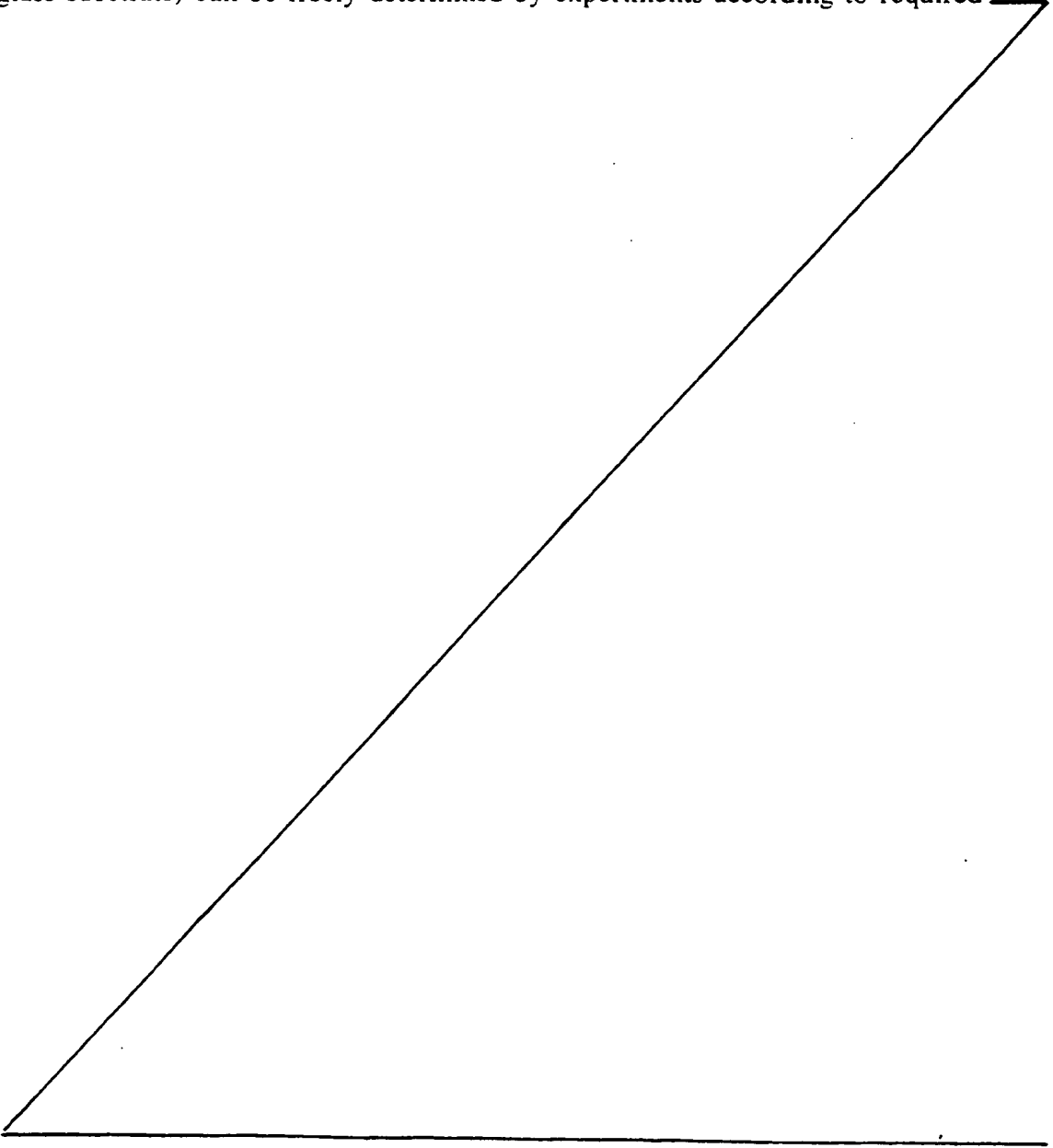
FIG.4 is a cross-sectional view schematically showing the configuration of the surface portion of a CRT according to a third embodiment of the display device
20 according to the present invention.

Below, preferred embodiments of the present invention will be explained in detail with reference to the drawings.

The display devices embodying the invention comprise a glass substrate, an anti-reflection film comprising a single layer or multiple layers formed on the glass

substrate and a functional coating layer comprising a compound made of a perfluoropolyether having a polar group at its end or a derivative thereof coated on the outermost layer of the anti-reflection film.

As the anti-reflection film comprising a single layer or multiple layers, various
5 combinations are possible. In the case of multiple layers, the substance forming the lower layers rather than the outermost layer (that is, the position farthest from the glass substrate) can be freely determined by experiments according to required



performances, for example, heat resistance, anti-reflection property, color of reflected light, durability, and surface hardness, etc. Note that, the outermost layer of the anti-reflection film is not particularly limited, but is desirably mainly composed of SiO_2 or MgF_2 , more preferably SiO_2 . This is because, when the outermost layer is mainly composed of SiO_2 or MgF_2 , a more sufficient surface hardness can be obtained, the dirt resistance and scratch resistance are improved and the durability of these performances becomes remarkable.

As the method of coating the various inorganic substances containing SiO_2 forming these anti-reflection films, there are various PVD (physical vapor deposition) processes represented by vacuum deposition, ion plating, and sputtering. As the inorganic substances suited to these PVD processes, inorganic oxides such as SiO_2 , Al_2O_3 , ZrO_2 , TiO_2 , TaHf_2 , SiO , TiO , Ti_2O_3 , Y_2O_3 , Yb_2O_3 , MgO , and CeO_2 are preferably applied.

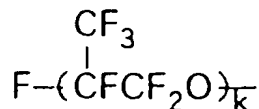
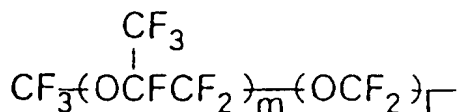
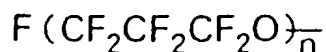
Further, the thickness of the outermost layer of the anti-reflection film must be determined according to the required performances other than the anti-reflection effect, but for the purpose of exhibiting the anti-reflection effect to the highest extent, selection of the optical thickness of the outermost layer to $1/4$ of the

wavelength of the light concerned or an odd number multiple thereof is preferred from the viewpoint of imparting the minimum reflectivity, that is, the maximum transmissivity.

5 As for the structure of the layers lower than the outermost layer in the anti-reflection film, it is not particularly limited. Namely, it is also possible to directly form and coat the outermost layer film on the glass substrate, but so as to make the anti-reflection
10 effect more conspicuous, it is effective that at least one layer of coating film having a higher refractive index than that of the outermost layer is formed on the glass substrate. Further, several proposals have been made concerning the selection of the thickness and the
15 refractive index of an anti-reflection film having such a multiple layer structure (for example, Optical Technology Contact, vol. 9, no. 8, p. 17 (1971)). They can be appropriately selected based on these known technologies.

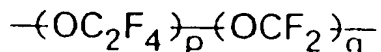
20 In the embodiments , a functional coating layer comprising a compound made of a perfluoropolyether having a polar group at its end or a derivative thereof is formed on the outermost layer of the anti-reflection film comprising a single layer or multiple layers.
25 Here, the molecular structure of the perfluoropolyether

or the derivative thereof is not particularly limited. It includes one having perfluoroalkoxyl groups of various chain lengths as the repeating units, and preferably it has C1 to C3 or so perfluoroalkoxyl groups as the repeating units. More specifically, as the monofunctional structure, there are for example those indicated next:



(1)

Further, as a polyfunctional structure, there is the one as follows:



(2)

Note that, in the above chemical structural formulae, l, m, n, k, p, and q respectively indicate an integer of 1 or more. As mentioned above, however, the molecular structure of the perfluoropolyether is not

limited to these examples.

The polar group arranged at one end or both ends of such a perfluoropolyether is not particularly limited. There can be mentioned for example an amino group, carboxyl group, hydroxyl group, alkoxysilyl group, and a phosphate group, but preferably groups exhibiting a good affinity and adsorption with respect to the material constituting the outermost layer of the anti-reflection film coated with the compound made of the perfluoropolyether or the derivative thereof are selected. For example, where the outermost layer of the reflection film is mainly composed of SiO_2 , an amino group, carboxyl group, hydroxyl group, alkoxysilyl group, or a phosphate group is selected. The same is true also for a case where the outermost layer film is mainly composed of MgF_2 .

As the compound made of the perfluoropolyether having a polar group at its end or a derivative thereof used in the case where the outermost layer film of the anti-reflection film is mainly composed of SiO_2 , a carboxylate salt with an amine having at its end an amino group bonded to a long chain hydrocarbon group is particularly preferred. Because, a compound made of a perfluoropolyether derivative having such a long chain hydrocarbon group is not only excellent in the

processability because of the increase in the number of usable solvents, as will be mentioned later, but also can give a more excellent abrasion resistance.

5 The molecular weight of the compound comprised of the perfluoropolyether having a polar group at it end or the derivative thereof is not particularly limited, but from the viewpoints of stability and easy handling, compounds having an average molecular weight of 500 to 10000, more preferably those having an average molecular
10 weight of about 1000 to 5000, are used.

The thickness of the functional coating layer formed by such a compound comprised of the perfluoropolyether having a polar group at its end or the derivative thereof is not particularly limited, but
15 from the viewpoints of the relationship with the balance between the anti-reflection property and the static contact angle with respect to water and the surface hardness, desirably the thickness is 0.5 nm to 100 nm, more preferably 1 nm to 20 nm.

20 As the coating method thereof, various methods used in usual coating work can be applied, but from the viewpoint of the uniformity of the anti-reflection effect and further the control of the reflection and interference color, spin coating, dip coating, curtain
25 flow coating, or the like is preferably used. Further,

from the viewpoint of the workability, a method in which a material such as paper or fabric is impregnated with the liquid and this is used to coat and spread it is preferably used.

5 In such coating work, the compound comprised of the perfluoropolyether having a polar group at its end or the derivative thereof is usually diluted by a volatile solvent for use. The type of the solvent used is not particularly limited, but at the time of use, it
10 should be determined by considering the stability of the composition, the wettability with respect to the outermost layer film of the anti-reflection film, the volatility, etc. In the case of a perfluoropolyether or a derivatives thereof not containing the long chain
15 hydrocarbon groups, the solvent is limited to a flon type solvent or a perfluoroalkane type solvent, but perfluoropolyether derivatives containing long chain hydrocarbon groups also dissolve in the ordinary organic
20 solvents, for example, alcohol solvents such as ethyl alcohol, ketone solvents such as an acetone, or hydrocarbon solvents such as hexane. Therefore, these may be used individually or as mixtures of two or more as the solvent. Note that, at the coating of the compound comprised of a perfluoropolyether having a
25 polar group at its end or the derivative thereof,

the surface of the anti-reflection film to be coated is preferably cleaned. At the time of the cleaning, dirt is removed by a surfactant, grease is removed by an organic solvent, a fluorocarbon type gas is used for washing, etc. Further, another effective means is to apply various pretreatments for the purpose of improvement of the bonding and durability. As the particularly preferably used methods, there can be mentioned the activated gas treatment, chemical treatment by an acid or alkali, etc.

Further, as the glass substrate used in the present invention, any material can be used so far as it is a substrate made of an inorganic silicon oxide, but from the viewpoints of the optical characteristics such as the transparency, refractive index, and dispersion and further various physical properties such as the shock resistance, heat resistance, and durability, silica glass containing Sr (Strontium) or Ba (Barium) is preferable particularly in a CRT and alkali-free glass etc. are preferred in a liquid crystal display etc. Further, as shown in the following embodiments, this glass substrate may be the glass panel of the display device per se and of course may be one different from the glass panel.

Below, the cross-sectional structure of the

surface portion of a CRT as one type of display device according to an embodiment of the present invention will be explained. First, an explanation will be made of the schematic view of the CRT.

5 As shown in FIG. 1, a CRT 10 has a glass panel 1 on the inside surface of which a fluorescent screen is formed and a funnel glass 14 which is bonded to this glass panel and accommodates in its neck an electron gun 16. The electron beam emitted from the electron gun
10 16 is polarized by a deflection yoke 18, passes through an aperture grill 20 serving as the shadow mask attached to the inner surface of the glass panel 1, and strikes upon the fluorescent screen to emit the light and thereby display the image.

15 In the first embodiment shown in FIG. 2, the anti-reflection film 2 is directly formed on the surface of the glass panel 1 of the cathode-ray tube (CRT) shown here as the display device. A functional coating layer 3 formed by coating a perfluoropolyether-
20 based compound having a polar group at its end is formed in an upper portion thereof.

 In the second embodiment shown in FIG. 3, a glass substrate 1B having a curvature corresponding to the curvature of the glass panel 1 of the CRT is provided,
25 and the anti-reflection film 2 and the functional

coating layer 3 similar to those described before are formed on this glass substrate 1B. Then, the filter material having such a structure is bonded to the glass panel 1 of the CRT via an adhesive layer 4 at the surface opposite to the surface on which the anti-reflection film is formed. Note that, the adhesive bonding the glass panel 1 and the glass substrate 1B is not particularly limited. Various well known adhesives can be used, but for example an epoxy resin type adhesive, acrylic resin type adhesive, a silicone type adhesive, or the like is used. The adhesive preferably has a refractive index of the hardened layer (bonded layer) thereof approximating the refractive index of the panel, for example, it has a difference of refractive index of 0.8 percent or less.

In the third embodiment shown in FIG. 4, similar to the embodiment shown in FIG. 3, there is a glass substrate 1B, and an anti-reflection film 2 and a functional coating layer 3 similar to the above are formed on this glass substrate 1B. However, unlike the embodiment shown in FIG. 3, the filter material having such a structure is merely arranged with the surface opposite to the surface on which the anti-reflection film is formed facing the front surface of the glass panel of the display device.

In the present invention, as the display device concerned, other than the CRT as described above, various display devices such as flat display devices, for example, a liquid crystal display device and plasma display device, are included.

The display device having such an anti-reflection filter embodying the present invention is resistant to dirt and allows the dirt to stand out less in comparison with a usual display device having an anti-reflection film. Further, it has the advantages such that dirt can be easily removed and scratches are hard to be formed due to the good surface slip. In addition to these performances, it has durability in respect to abrasion of the filter.

Examples

Below, the present invention will be explained in further detail by examples. However, the present invention is not limited to these examples. Note that, in the examples, the term "parts" means "parts by weight".

Example 1

(1) Preparation of anti-reflection film

The surface of the glass panel of a CRT was coated with an anti-reflection film by first depositing ITO to a thickness of 130 nm by the

sputtering process, then depositing SiO_2 to 80 nm.

(2) Adjustment of coating composition containing perfluoropolyether-based compound having polar group at its end

5 380 parts of hexane and 20 parts of ethanol were added to and mixed in 0.4 part of the perfluoropolyether having a polar group at its end shown in Table 1 (average molecular weight of 2000, lubricant 1 of Table 1) to prepare a homogenized
10 solution which was then filtered by a membrane filter to obtain the coating composition.

(3) Coating of coating composition and drying

The coating composition obtained in the above (2) was dip-coated on the surface of the anti-
15 reflection film obtained in the above (1) at a pull-up speed of 5 cm/min to obtain an optical member having an anti-reflection property.

(4) Evaluation of performances

The performances of the obtained optical
20 member were evaluated by performing tests according to the following methods. The results are shown in Table 1.

(a) Dirt resistance test

Five ml of tap water was dropped onto the filter surface and was left to stand for 48 hours under
25 an atmosphere of room temperature $25^\circ\text{C} \pm 2^\circ\text{C}$, then was

wiped off with a cloth. The residual presence of dirt from the water at this time was observed. The case where the residual dirt could be removed was evaluated as "good" and the case where it could not be removed was evaluated as "poor".

(b) Surface slip test

A formation of scratches when scratching the surface by the tip of a mechanical pencil under a load of 200 g was evaluated. The judgements were made according to the following criteria:

- o: No scratches at all
- Δ: Fine scratches formed
- x: Conspicuous scratches

(c) Abrasion resistance test

It was confirmed by whether or not scratches were formed on the surface of the anti-reflection filter after rubbing the same 30 times using steel wool #0000 under a load of 200 g.

- o: No scratches at all
- Δ: Fine scratches formed
- x: Conspicuous scratches

(d) Resistance to hand marks test

The resistance to hand marks when the anti-reflection filter was touched by the hand was evaluated visually. The judgements were made according

to the following criteria.

- o: Does not stand out even if formed
- Δ : Forms, but can be easily removed
- x: Forms and then stands out

5 Examples 2 to 10

Optical members were obtained and were evaluated as to their performance in exactly the same way as in Example 1 except the lubricants 2 to 10 of the compositions shown in Table 1 were used in place of the lubricant 1. The obtained results are shown in Table 1.

Comparative Examples 1 to 5

For comparison, optical members not coated with a perfluoropolyether-based compound having a polar group at its end and coated with other fluorocarbon resins were evaluated as to their performances in the same way as for the examples. The obtained results are shown in Table 2.

[Table 1]

Perfluoropolyether-Based Lubricant Used

Lubricant	Molecular structure	Dirt resistance	Surface slip	Abrasion resistance test	Resistance to hand marks
Lubricant 1	$RN^*H_3O^+OCCF_2(CF_2O)_n(C_2F_5O)_mCF_2COON^*H_3R$	Good	0	0	0
Lubricant 2	$F(CF_2CF_2CF_2O)_nCF_2CF_2COON^*H_3R$	Good	0	0	0
Lubricant 3	CF_3 $F(CF_2CF_2O)_nCF_2CF_2COON^*H_3R$	Good	0	0	0
Lubricant 4	$F(CF_2CF_2CF_2O)_nCF_2CF_2COON^*H_3R_1$	Good	0	0	0
Lubricant 5	$F(CF_2CF_2CF_2O)_nCF_2CF_2COON^*H_3R_2$	Good	0	0	0
Lubricant 6	$F(CF_2CF_2CF_2O)_nCF_2CF_2COON^*H_3R_3$	Good	0	0	0
Lubricant 7	$F(CF_2CF_2CF_2O)_nCF_2CF_2COON^*H_3R_4$	Good	0	0	0
Lubricant 8	$F(CF_2CF_2CF_2O)_nCF_2CF_2COON^*H_3R_5$	Good	0	0	0
Lubricant 9	$HOCH_2CF_2(CF_2O)_n(C_2F_5O)_mCF_2CH_2OH$	Good	0	0	0
Lubricant 10	$HOCOCH_2(CF_2O)_n(C_2F_5O)_mCF_2COOH$	Good	0	0	0

Here, $R_1=C_{18}H_{37}$; $R_2=C_{14}H_{29}$; $R_3=C_{10}H_{21}$; $R_4=C_{18}H_{37}$; $R_5=C_{18}H_{37}$; $R_6=C_{18}H_{37}$; $R_7=C_{18}H_{37}$; $R_8=C_{18}H_{37}$; $R_9=C_{18}H_{37}$; $R_{10}=C_{18}H_{37}$.

[Table 2]

Surface Coating Agent Used in Comparative Examples

Lubricant	Molecular structure	Dirt resistance	Surface slip	Abrasion resistance test	Resistance to hand marks
Comp. Ex. 1	No coating agent	Poor	Δ	Δ	x
Comp. Ex. 2	Polytetrafluoroethylene	Good	Δ	o	o
Comp. Ex. 3	Polyvinylidenefluoride	Good	Δ	o	o
Comp. Ex. 4	Tetrafluoroethylene-ethylene copolymer	Good	Δ	o	o
Comp. Ex. 5	Chlorotrifluoroethylene-ethylene copolymer	Good	Δ	o	Δ

As mentioned above, by coating a perfluoropolyether-based compound having a polar group at its end on the outermost surface of an anti-reflection film comprising a single layer or multiple layers formed on the glass substrate, the abrasion resistance or dirt resistance of the filter for the display device having an anti-reflection property was improved.

When the compound is coated on the outermost surface of the anti-reflection film, the polar groups of the ends of the compound are strongly adsorbed on the surface of the anti-reflection film and cover the film surface, therefore a good durability is exhibited. On the other hand, the perfluoropolyether chains of this compound exhibit a hydrophobic property, therefore by orienting them in a direction where they become far from the film surface, they ease the shock at the contact of a foreign substance from the outer surface and, at the same time, flexibly swing in the direction of shock so scratching of the surface can be avoided. At the same time, a good dirt resistance is imparted due to the high water repellency or a low wettability with respect to various media of the perfluoropolyether chains.

The display devices embodying the present

invention have the following effects.

(1) Dirt due to finger marks, hand marks, etc. has hard time adhering or standing out and these effects are permanently held.

5 (2) Even if a residual dirt from water adheres and dries, it can be easily removed.

(3) The surface slip is good.

(4) Dust and other dirt have a hard time adhering and the usability is good.

10 (5) There is a durability with respect to the abrasion.

CLAIMS

1. A display device having an anti-reflection filter comprising:

5 a glass substrate;

an anti-reflection film comprising a single layer or multiple layers formed on the glass substrate; and

10 a functional coating layer comprising a compound made of a perfluoropolyether having a polar group at its end or a derivative thereof coated on the outermost layer of the anti-reflection film.

2. A display device according to claim 1, wherein said glass substrate comprises a glass panel of the display device.

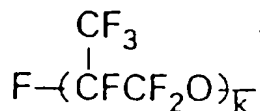
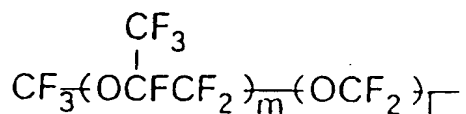
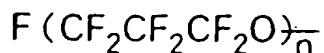
3. A display device according to claim 1, wherein said outermost layer of the anti-reflection film is mainly composed of SiO_2 or MgO_2 .

4. A display device according to claim 1, wherein at least one layer of coating film having a higher refractive index than that of the outermost layer is formed on the glass substrate.

5. A display device according to claim 1, wherein molecular structure of the compound made of the perfluoropolyether having a polar group at its end or a

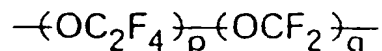
derivative thereof has perfluoroalkoxyl groups of the various chain lengths as repeating units.

6. A display device according to claim 4, wherein said perfluoroalkoxyl groups have any one of the structures indicated by the following chemical formulae:



where l, m, n and k indicate an integer of 1 or more respectively.

7. A display device according to claim 4, wherein said perfluoroalkoxyl groups have any one of the structure indicated by the following chemical formula:



where p and q indicate an integer of 1 or more respectively.

8. A display device according to claim 1, wherein

said polar group which the compound made of a perfluoropolyether or a derivative thereof has at its end is any one of amino group, carboxyl group, hydroxyl group, alkoxysilyl group and phosphate group.

5 9. A display device according to claim 1, wherein said compound made of a perfluoropolyether having a polar group at its end or a derivative thereof has an average molecular weight of 500 to 10000.

10 10. A display device according to claim 1, wherein said compound made of a perfluoropolyether having a polar group at its end or a derivative thereof has an average molecular weight of 1000 to 5000.

15 11. A display device according to claim 1, wherein said functional coating layer comprising a perfluoropolyether having a polar group at its end or a derivative thereof has a thickness of 0.5nm to 100nm.

20 12. A display device according to claim 1, wherein said functional coating layer comprising a perfluoropolyether having a polar group at its end or a derivative thereof has a thickness of 1nm to 20nm.

13. A display device having an anti-reflection filter, substantially as herein described with reference to the accompanying drawings.

14. A display device according to any one of the preceding claims, which is a cathode ray tube.



Application No: GB 9621168.5
Claims searched: 1-14

Examiner: John Warren
Date of search: 5 February 1997

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): B2E

Int Cl (Ed.6): G02B 1/10; H01J 29/89

Other: Online database: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	EP 0,203,730 A2 TORAY - see Claims 1 and 3	
A	US 5,476,717 FLOCH - see Claim 1	
A	US 5,139,879 AHARONI - see Example 11 and also Claim 2 where perfluorinated monomers having ether linkages are specified	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.